BPHCT-137

ASSIGNMENT BOOKLET

BACHELOR'S DEGREE PROGRAMME
(BSCG/BSCM)

WAVES AND OPTICS

Valid from 1st January, 2026 to 31st December, 2026

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068
(2026)

Dear Student,

Please read the section on assignments in the Programme Guide for B. Sc. that we sent you after your enrolment. A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, **which would consist of one tutor-marked assignment** for this course. The assignment is in this booklet, and it consists of two parts, Part A and B. The total marks of all the parts are 100, of which 35% are needed to pass it.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully:

1) On top of the first page of your answer sheet, please write the details exactly in the following format:

ROLL NO.: ……

NAME: ……

ADDRESS: ……

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COURSE CODE:…….

COURSE TITLE: ……

ASSIGNMENT CODE: ……..

STUDY CENTRE: …….. **DATE:** ……...

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.
3) Leave 4 cm margin on the left, top and bottom of your answer sheet.
4) Your answers should be precise.
5) Solve Part A and Part B of this assignment, and **submit the complete assignment answer sheets containing Parts A and B within the due date.**
6) The assignment answer sheets are to be submitted to your Study Centre as per the schedule. **Answer sheets received after the due date shall not be accepted.**

   We strongly suggest that you retain a copy of your answer sheets.
7) This assignment is **valid from 1st January, 2026 to 31st December, 2026**. If you have failed in this assignment or fail to submit it by 31st December, 2026, then you need to get the assignment for the year 2027, and submit it as per the instructions given in the Programme Guide.
8) **You cannot fill the examination form for this course** until you have submitted the assignment for the course. For any queries, please contact: srjha@ignou.ac.in, drsgupta@ignou.ac.in.

   We wish you good luck.

Tutor Marked Assignment
WAVES AND OPTICS

Course Code: BPHCT-137
Assignment Code: BPHCT-137/TMA/2026
Max. Marks: 100

Note: Attempt all questions. The marks for each question are indicated against it.

PART A

1. a) The sodium lamp used in a physics laboratory gives out light uniformly. Suppose that the lamp uses 40 W. Calculate the magnitude of electric field. (5)

   b) Describe polarisation of light by reflection. How does degree of polarisation vary with angle of incidence of light? (5)

   c) Discuss the concept of missing orders with reference to double slit diffraction pattern. (5)

   d) Depict spatial evolution of Fresnel diffraction pattern. (5)

2. a) Obtain expressions for reflection and transmission amplitude coefficients when electric vector associated with a plane monochromatic electromagnetic wave is in the plane of incidence. (10)

   b) Obtain an expression for elliptically polarised light resulting due to superposition of two orthogonal linearly polarised light waves. Show that plane polarised light and circularly polarised light are special cases of elliptically polarised light. (10)

3. a) Obtain the expression for shift in fringes when a thin transparent sheet is introduced in the path of one of the waves in a double slit interference experiment. (10)

   b) A plano-convex lens of radius 1.0 m is placed on an optically flat glass plate and is illuminated by an extended monochromatic source. Assume that the point of contact is perfect. The diameters of the 10th and 5th dark rings in the reflected light are 4.50×10^{-3} m and 3.36×10^{-3} m. Next, the space between the lens and the glass plate is filled with a liquid. The diameter of the 5th ring changes to 3.0×10^{-3} m. Calculate the refractive index of the liquid when the ring is (i) dark, and (ii) bright, if the wavelength of light is 589 nm. (10)

PART B

4. a) A plane light wave of wavelength 580 nm falls on a long narrow slit of width 0.5 mm. (i) Calculate the angles of diffraction for the first two minima. (ii) How are these angles influenced if the width of slit is changed to 0.2 mm? (iii) If a convex lens of focal length 0.15 m is now placed after the slit, calculate the separation between the second minima on either side of the central maximum. (10)

   b) Discuss Rayleigh's criterion for resolving power of an optical instrument. Obtain an expression for resolving power of a microscope. (10)

5. a) An atomic system consisting of two energy levels, with population of higher energy level less than that of the lower level, is in thermal equilibrium. Show that the absorption of radiation dominates stimulated emission if radiation of appropriate frequency is introduced into the system. Comment on the consequences of this fact for laser action. (10)

b) Two energy levels of an atomic system are separated by energy corresponding to frequency 3.0×10^{14} Hz. Assume that all atoms are in one or the other of these two energy levels, compute the fraction of atoms in the upper energy level at temperature 400 K. Take $k_B = 1.38 \times 10^{-23}\,\mathrm{JK}^{-1}$ and $h = 6.6 \times 10^{-34}$ Js. (5)

c) The refractive indices of the core and cladding materials of an optical fibre are 1.51 and 1.39, respectively. Calculate the numerical aperture and light gathering capacity of the fibre. (5)

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